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University of Washington Correspondence

INTERDEPARTMENTAL

13 April 1990

To: Resident Representative
Office of Naval Research, UW

From: Terry E. Ewart, Principal Investigator
Ocean Physics Dept., APL/UW

RE: Transmittal letter for Final Technical Report
ONR Grant N00014-89-J-1937

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Attached is the Final Technical Report for the one-year grant, Multi-discipline Group Reverberation SRP Program Propagation, Terry E. Ewart, Principal Investigator. Under separate cover I am sending three copies to the Scientific Officer, one copy to the Director of NRL and 12 copies to DTIC.

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ONR Grant N00014-89-J-1937

Multi-Discipline Group Reverberation SRP FY89 Program: Final Report

Terry E. Ewart, Eric I. Thorsos, and Darrell R. Jackson

This project was carried out as part of the Office of Naval Research Special Research Project in ocean acoustic surface and bottom reverberation. Several workshops were attended as part of the planning process of the program, and participation in, and preparation for, those workshops was supported under this project. Two tasks were performed under this grant.

The first task was to design an array capable of producing a "Pencil Beam" radiation pattern. The task included a preliminary design of the array, including a stress analysis and a dynamic analysis of the preliminary design. All of the elements of this design and analysis was reported in our proposal to ONR for FY90. Succinctly, we were able to demonstrate the capability of the array to make the surface scattering measurements that were defined during the SRP planning process. The dynamic analysis indicated that the array could be operated in currents up to 20 cm/s. The beam patterns and source levels of the proposed array were shown to allow surface scattering cross section measurements down to 10 ° grazing angles at low sea states for which surface roughness alone is responsible for the scattering.

The second task was the design, construction, and testing of a prototype 400 Hz chime transducer. Two were built and tested. The transducers actually built were quite different from the APL chime transducer. During the course of initial design, it was shown by theoretical analysis that the APL chime transducer design could not work at such low frequencies. (The lowest frequency chime built to date was 2 kHz.) The problem with the chime design at low frequencies is that fluid leaks past the individual tines during a single cycle, and shunts the acoustic output. The new design, developed by Terry Ewart and Elbert Pence uses a bender bar with a ceramic element bonded to it at elevated temperatures. When the bar/ceramic cools, the ceramic is left in compression. This biases the element, so that the ceramic operates only in compression when voltages to 3000 v are applied. The bender bars are operated in a fundamental or first harmonic "clamped end" mode, and special care is taken to ensure that the gaps around the tines are optimized. The optimum gap is that for which the leakage is as small as possible for tolerable viscous losses. The two prototypes showed that we should be able to obtain between 180 dBμPa and 185 dBμPa in a final design with reasonable drive voltages. These levels are sufficient for the proposed array elements. This completes the work proposed.

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